BP Products North America Inc.
2815 Indianapolis Blvd.
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Whiting, IN 46394-0710
USA

June 22, 2015

Director, Air Enforcement Division
Office of Civil Enforcement (2242A)
Office of Enforcement and Compliance Assurance
United States Environmental Protection Agency
1200 Pennsylvania Ave., N.W.
Washington, DC 20004

Compliance Tracker (AE-17J)
Air Enforcement and Compliance Assurance branch
U.S. EPA, Region 5
77 W. Jackson Blvd.
Chicago, IL 60604

Office of Regional Counsel
U.S. EPA, Region 5
77 West Jackson Blvd. (C-14J)
Chicago, IL 60604

Re: **United States, et.al. v. BP Products North America Inc.**
Northern District of Indiana, Hammond Division
Civil Action No. 2:12 CV 207
Emissions and Flare Combustion Efficiency Test Results

As required by Appendix D, ¶ 18 of the BP Whiting Consent Decree (CD), BP is submitting the Initial Waste Gas Minimization Plan (WGMP) for each Covered Flare, discussing and evaluating flaring prevention measures both refinery-wide and on a flare-specific basis.

If you require additional information, please contact Rohini Sengupta at (219) 473-2110.

Sincerely,

Linda Wilson RmH

Linda Wilson
Environmental Manager
BP Whiting Business Unit

Attachment

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Submitted hard-copy:

cc w/o attachment:

Chief
Environmental Enforcement Section
Environment and Natural Resources Division
U.S. Department of Justice
P.O. Box 7611
Ben Franklin Station
Washington, DC 20044-7611
Reference Case No. 90-5-2-1-09244

cc w/ attachment:

Office of the Indiana Attorney General
Environmental Litigation Division
Indiana Government Center South- Fifth Floor
302 West Washington Street
Indianapolis, IN 46204

Chief, Air Compliance and Enforcement Branch
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Director, Air Enforcement Division
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c/o Matrix New World Engineering, Inc.
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East Hannover, NJ 07936-3159
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Distribution of an enclosed flash drive with the test data and video is limited to the following:

Director, Air Enforcement Division, OECA

Compliance Tracker - U.S. EPA, Region 5

Matrix New World Engineering, Inc.

Chief, Air Compliance and Enforcement Branch, IDEM

SAGE
ENVIRONMENTAL CONSULTING

Waste Gas Minimization Plan

BP Products North America
Whiting Refinery

Revision 0

June 2015

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LIST OF FIGURES

LIST OF ATTACHMENTS

SECTION 1
INTRODUCTION

BP Products North America Inc. (BPP) operates the Whiting Refinery located at 2815 Indianapolis Blvd, Whiting, Indiana. The facility refines crude oil into various petroleum products and is organized into several groups of process units designed to maximize the production of transportation fuels. Figure 1-1 shows the Whiting Refinery layout. The refining process utilizes physical and chemical reactions which require increased temperatures and/or pressures. Critical elements of most process equipment are pressure relief devices used to ensure process equipment do not become over-pressurized and create a safety hazard. To limit the emission of hydrocarbon constituents from these relief devices, they are collected in a header system and processed in a safe manner in a refinery flare system. Refinery flares are designed to accept a broad range of gas flow rates and compositions which may result from emergency conditions or small leaks in relief devices. Flare systems vary greatly depending on the application and specific conditions present in the process units having connections to the flare header system.

Every flare system consists of a relief gas header system, otherwise referred to as "flare header system" or "Waste Gas header system", which provides a controlled outlet for any excess vapor flow. Each relief gas header has connections to depressurization and purging relief devices related to maintenance turnaround, startup, and shutdown, as well as other pressure relief devices and safety control devices to handle emergency situations. Typically, relief gas header systems incorporate a knockout drum for separation of liquids entrained in the Waste Gases. Liquids can cause damage to flare systems and create a serious safety concern. Liquids from the knockout drum are sent for treatment and then recycled back into the refinery process. Gases are routed to the flare tip or to flare gas recovery devices.

Keeping air from leaking into the system is critical to preventing excess oxygen from entering the relief flare header. This is typically accomplished by maintaining a slightly positive pressure in the header via the use of a liquid seal at a point prior to the flare tip. A liquid seal creates a barrier to uninterrupted flow which must be overcome prior to having gas flow to the flare tip. Additionally, it isolates the flare tip, a potential source of ignition, from the header system and the rest of the process unit. Alternatively, a gas may be used to constantly purge the header system to maintain a positive pressure in the header. A velocity seal may be installed at the base of the flare tip to limit the amount of Purge Gas required to prevent backflow.

Gas exits the flare via a tip which is specially designed to promote combustion over a range of flow rates and reduce noise. Steam is used to increase mixing at the flare tip, improve combustion efficiency, and reduce smoking. Natural gas is used as Pilot Gas at the flare tip to keep a pilot light burning, to provide a positive pressure at the flare tip to promote upward flow, and to help increase the Net Heating Value (NHV) as Supplemental Gas, if flare gas has low BTU content. Properly designed and operated flare systems can achieve greater than 98 percent combustion efficiency, producing mainly carbon dioxide (CO_2) and water. Other compounds may be present depending on the source of the flow to the flare. For example, sulfur dioxide (SO_2) may be present if there are sulfur-containing compounds present in the flare gas.

1.1 Whiting Refinery Flare System

Flare systems are essential refinery safety equipment used to combust gases that would otherwise be released to the environment. Without the combustion that flares are designed to provide, potentially dangerous gases could be released, creating a health hazard to workers and refinery neighbors. Additionally, released gases create a fire hazard if not properly handled and controlled through a flare system. The gases handled by flare systems are released from relief valves, pump seals, and many other devices designed to keep the refinery safe and reduce fugitive emissions.

The Whiting Refinery has eight (8) Covered Flares which are subject to this Waste Gas Minimization Plan (WGMP). These flares are the Vapor Recovery Unit (VRU), Fluidized Catalytic Cracking Unit (FCU), Alkylation (Alky), #4 Ultraformer (4UF), Ultraformate Isomerization Ultrafining (UIU), South, Gas-Oil Hydrotreater (GOHT), and Distillate Desulfurization Unit (DDU) Flares.

Each flare was designed to serve specific process units in the refinery with various quantities and compositions of Waste Gas being routed to them.

1.2 Waste Gas Minimization Plan Requirements

This WGMP was prepared to discuss and evaluate flaring preventive measures both Refinery-wide and on a flare-specific basis. It was prepared to comply with the requirements of Paragraphs 18-21 in Appendix D of the Consent Decree between the United States and BP Products North America (Consent Decree), case number 2:12-CV-00207-PPS-APR, entered with the United States District Court for the Northern District of Indiana (Hammond Division) on November 6, 2012. In accordance with the Consent Decree, this WGMP is due June 30, 2015. An evaluation of the effectiveness of and revision to the initial WGMP must be made within 12 months following implementation of the initial WGMP and annually thereafter. It must also be updated following any change to the information, diagrams, and drawings provided in the Flare Data and Monitoring Systems and Protocol Report required under Paragraph 5 in Appendix D of the Consent Decree. In addition, this WGMP will be used in conjunction with the Flare Management Plans (FMPs) that have been prepared for the Covered Flares by complying with 40 CFR 60 Subpart Ja per Paragraph 22 in Appendix D of the Consent Decree.

The Consent Decree stipulates that the elements of the initial WGMP include:

- If and as necessary, updates to the information submitted in the Flare Data and Monitoring Systems and Protocol Report;
- The volumetric and mass flow rates, in scfm and lb/hr, respectively, of Waste Gas sent to each Covered Flare over the period from January 1, 2014 through December 31, 2014, on a 30-day rolling average;
- The baseload Waste Gas flow rate, in scfd, to each Covered Flare, excluding South Flare and GOHT. The baseload calculation will exclude periods of Startup, Shutdown, and Malfunction. The baseload flow rate will cover the period from January 1, 2014 through December 31, 2014;

ii. "HC Flaring Incident – Trigger 2": the combustion of 500,000 standard cubic feet or more of Waste Gas (excluding Acid Gas, Sour Water Stripper Gas, and Tail Gas) within a 24-hour period at a Hydrocarbon Flare. For purposes of calculating Waste Gas flow rate, the following flows may be excluded: (i) the pro-rated Baseload Waste Gas Flow Rate (pro-rated on the basis of the duration of the Flaring Incident); and (ii) if BPP has instrumentation capable of measuring the volumetric flow rate of hydrogen, nitrogen, oxygen, carbon monoxide, carbon dioxide, and/or steam in the Waste Gas, the contribution of all measured flows of any of these elements/compounds. Subsequent, contiguous, non-overlapping periods are measured from the initial commencement of Flaring within the HC Flaring Incident. When HC Flaring occurs within a 24-hour period at more than one HC Flare, the volume of Waste Gas attributable to HC Flaring emitted from each HC Flare shall be added together for purposes of determining whether there is one HC Flaring Incident, unless the root causes of the flaring at the various HC Flaring Devices are not related to each other.

- "Pilot Gas" shall mean all gas introduced through the pilot tip of a Flare to maintain a flame.
- "Purge Gas" shall mean the minimum amount of gas introduced between a Flare header's water seal and the Flare tip to prevent oxygen infiltration (backflow) into the Flare tip. For a Flare with no water seal, the function of Purge Gas is performed by Sweep Gas, and therefore, by definition, such a Flare has no Purge Gas.
- "Sweep Gas" shall mean:
  - For a Flare with a Flare Gas Recovery System: the minimum amount of gas introduced into a Flare header in order to: (a) prevent oxygen buildup, corrosion, and/or freezing in the Flare header; and (b) maintain a safe flow of gas through the Flare header. Sweep Gas in these Flares is introduced prior to and is intended to be recovered by the Flare Gas Recovery System;
  - For a Flare without a Flare Gas Recovery System: the minimum amount of gas introduced into a Flare header in order to: (a) prevent oxygen buildup, corrosion, and/or freezing in the Flare header; (b) maintain a safe flow of gas through the Flare heater; and (c) prevent oxygen infiltration (backflow) into the Flare tip.
- "Supplemental Gas" shall mean all gas introduced to a Flare to comply with the net heating value requirements of 40 C.F.R. § 60.18(b), 40 C.F.R. § 63.11(b), and/or Paragraph 33 of this Appendix.
- "Vent Gas" shall mean the mixture of all gases found prior to the Flare tip. This gas includes all Waste Gas, Sweep Gas, Purge Gas, and Supplemental Gas, but does not include Pilot Gas, Total Steam, or Assist Air.
- "Waste Gas" shall mean the mixture of all gases from facility operations that is directed to a flare for the purpose of disposing of the gas. "Waste Gas" does not include gas introduced to a flare exclusively to make it operate safely and as intended; therefore, "Waste Gas" does not include Pilot Gas, Total Steam, Assist Air, or the minimum amount of Sweep Gas and Purge Gas that is necessary to perform the functions of Sweep Gas and Purge Gas. "Waste Gas" also does not include gas introduced to a flare to

Flare	Unit	Equipment	Type of Equipment
		TGU-A	Tail Gas Unit
		TGU-B	Tail Gas Unit
	VRU-400	PRVs	Process Unit
GOHT	GOHT	PRVs	Process Unit
DDU	11A Pipestill	PRVs	Process Unit
	11C Pipestill	PRVs	Process Unit
	DDU	PRVs	Process Unit
	DHT	PRVs	Process Unit

BPP currently has no plans for the removal of any Covered Flares from service. Future revisions of this document will include the required details if any Covered Flares become scheduled for decommissioning.

It should be noted that there is a configuration by which the FCU 600 unit is connected to the VRU Flare through piping and a normally closed valve. This configuration is intended to provide a means of allowing the FCU 600 unit to continue to operate during times of an FCU Flare shutdown or turnaround. This same configuration allows FCU 500 to be routed to the FCU Flare during a VRU Flare shutdown or turnaround. Further details are provided in Section 2.1.1.

2.1.2 Waste Gas Volumetric and Mass Flow Rates

The Waste Gas volumetric and mass flow rates can be determined for the flare systems by utilizing an ultrasonic flow meter and gas chromatograph (GC). The volumetric flow rate of the Vent Gas can be derived by an ultrasonic flow meter by determining the Vent Gas velocity and using the known inner diameter of the pipe in which the flow meter is installed. The GC allows for the calculation of the Waste Gas volumetric and mass flow rates by determining the composition of the Vent Gas so that inert species within the Vent Gas (Hydrogen, Oxygen, Nitrogen, Carbon Monoxide, Carbon Dioxide, and Water/Steam) can be excluded from the calculations. The average Waste Gas volumetric and mass 30 day average flow rates for the VRU Flare (found below in Table 2-1) were determined using data collected between January 1, 2014 and December 31, 2014.

Table 2-1
VRU Flare Waste Gas Volumetric and Mass Flow Rates

Waste Gas Volumetric Flow Rate (scfm)	Waste Gas Mass Flow Rate (pounds per hour)
187.2	609.0

2.1.3 Baseload Waste Gas Flow Rate

The baseload Waste Gas flow rate can be determined for the flare systems by utilizing an ultrasonic flow meter and gas chromatograph (GC). The flow meter is capable of calculating the volumetric flow rate of the Vent Gas by determining the Vent Gas velocity and using the known inner diameter of the pipe in which the flow meter is installed. The GC allows for the calculation of the Waste Gas volumetric flow rate by determining the composition of the Vent Gas and so that inert species within the Vent Gas (Hydrogen, Oxygen, Nitrogen, Carbon Monoxide, Carbon Dioxide, and Water/Steam) can be excluded from the calculations. The Waste Gas flow rate reflects only the VOC content of the overall Vent Gas composition. The average baseload Vent Gas flow rate and the average baseload Waste Gas flow rate for the VRU Flare (found below in Table 2-2) were determined using data collected between January 1, 2014 and December 31, 2014.

Table 2-2
VRU Flare Vent Gas and Waste Gas Volumetric Flow Rates

Vent Gas Volumetric Flow Rate (scfd)	Waste Gas Volumetric Flow Rate (scfd)
897,402	331,318

2.1.4 Identification of Constituent Gases

Under normal refinery operating conditions, gases vented to the flare from the various refinery units have a typical composition. This gas composition varies between flares due to the difference in the functions of the units each flare services. Gas composition is determined through the use of a gas chromatograph (GC). This average composition can vary during flaring incidents related to startup, shutdown, maintenance and turnaround activities, as well as emergency flaring situations. The following Table 2-3 shows

Table 2-4
VRU Flare Reductions Previously Realized

Year Installed or Implemented	Description	Estimated Reductions
2013	Sweep Gas Rotameter Study conducted to identify minimum Sweep Gas rate required for prevention of backflow resulting from thermal contraction	NA
2013	Initial Pressure Relief Valve Leak Survey	NA
2012 – Present	Monthly Preventative Maintenance Rounds conducted by Operations to identify leaking PRVs	NA

2.1.7 Flare Specific Planned Reductions

Pursuant to the requirements set forth in the Consent Decree, future preventive measures are summarized in Table 2-5 below along with an anticipated schedule and potential reductions, where capable of being determined.

Table 2-5|
VRU Flare Planned Reductions

Estimated Completion Date	Description	Estimated Reductions
December 31, 2015	Install and commence operation of Flare Gas Recovery System 3, in accordance with the requirements of the BP Whiting Consent Decree.	331 MSCFD*

*Flare Gas Recovery will also absorb some portion of contributions from Startup, Shutdown, and Malfunction; BPP expects the actual reduction to exceed the baseload volume.

Water/Steam) can be excluded from the calculations. The average Waste Gas volumetric and mass 30 day average flow rates for the FCU Flare (found below in Table 2-6) were determined using data collected between January 1, 2014 and December 31, 2014.

Table 2-6
FCU Flare Waste Gas Volumetric and Mass Flow Rates

Waste Gas Volumetric Flow Rate (scfm)	Waste Gas Mass Flow Rate (pounds per hour)
50.7	175.2

2.2.3 Baseload Waste Gas Flow Rate

The baseload Waste Gas flow rate can be determined for the flare systems by utilizing an ultrasonic flow meter and gas chromatograph (GC). The flow meter is capable of calculating the volumetric flow rate of the Vent Gas by determining the Vent Gas velocity and using the known inner diameter of the pipe in which the flow meter is installed. The GC allows for the calculation of the Waste Gas volumetric flow rate by determining the composition of the Vent Gas and so that inert species within the Vent Gas (Hydrogen, Oxygen, Nitrogen, Carbon Monoxide, Carbon Dioxide, and Water/Steam) can be excluded from the calculations. The Waste Gas flow rate reflects only the VOC content of the overall Vent Gas composition. The average baseload Vent Gas flow rate and the average baseload Waste Gas flow rate for the FCU Flare (found below in Table 2-7) were determined using data collected between January 1, 2014 and December 31, 2014.

Table 2-7
FCU Flare Vent Gas and Waste Gas Volumetric Flow Rates

Vent Gas Volumetric Flow Rate (scfd)	Waste Gas Volumetric Flow Rate (scfd)
209,965	90,008

2.2.4 Identification of Constituent Gases

Under normal refinery operating conditions, gases vented to the flare from the various refinery units have a typical composition. This gas composition varies between flares due to the difference in the functions of the units each flare services. Gas composition is determined through the use of a gas chromatograph (GC). This average composition can vary during flaring incidents related to startup, shutdown, maintenance and turnaround activities, as well as emergency flaring situations. The following Table 2-8 shows composition data that is typical for the FCU Flare for the time between January 1, 2014 and December 31, 2014.

Table 2-9
FCU Flare Reductions Previously Realized

Year Installed or Implemented	Description	Estimated Reductions
2013	Sweep Gas Rotameter Study conducted to identify minimum Sweep Gas rate required to prevent backflow resulting from thermal contraction	NA
2013	Initial Pressure Relief Valve Leak Survey	NA
2012 – Present	Monthly Preventative Maintenance Rounds conducted by Operations to identify leaking PRVs	NA

2.2.7 Flare Specific Planned Reductions

Pursuant to the requirements set forth in the Consent Decree, future preventive measures are summarized in Table 2-10 below along with an anticipated schedule and potential reductions, where capable of being determined.

Table 2-10
FCU Flare Planned Reductions

Estimated Completion Date	Description	Estimated Reductions
December 31, 2015	Install and commence operation of Flare Gas Recovery System 3, in accordance with the requirements of the BP Whiting Consent Decree.	90 MSCFD*

*Flare Gas Recovery will also absorb some portion of emissions contributions from Startup, Shutdown, and Malfunction; BPP expects the actual reduction to exceed the baseload volume.

Table 2-11
Alky Flare Waste Gas Volumetric and Mass Flow Rates

Waste Gas Volumetric Flow Rate (scfm)	Waste Gas Mass Flow Rate (pounds per hour)
161.5	1003.4

2.3.3 Baseload Waste Gas Flow Rate

The baseload Waste Gas flow rate can be determined for the flare systems by utilizing an ultrasonic flow meter and gas chromatograph (GC). The flow meter is capable of calculating the volumetric flow rate of the Vent Gas by determining the Vent Gas velocity and using the known inner diameter of the pipe in which the flow meter is installed. The GC allows for the calculation of the Waste Gas volumetric flow rate by determining the composition of the Vent Gas and so that inert species within the Vent Gas (Hydrogen, Oxygen, Nitrogen, Carbon Monoxide, Carbon Dioxide, and Water/Steam) can be excluded from the calculations. The Waste Gas flow rate reflects only the VOC content of the overall Vent Gas composition. The average baseload Vent Gas flow and the average baseload Waste Gas flow rate for the Alky Flare (found below in Table 2-12) were determined using data collected between January 1, 2014 and December 31, 2014.

Table 2-12
Alky Flare Vent Gas and Waste Gas Volumetric Flow Rates

Vent Gas Volumetric Flow Rate (scfd)	Waste Gas Volumetric Flow Rate (scfd)
798,030	231,306

2.3.4 Identification of Constituent Gases

Under normal refinery operating conditions, gases vented to the flare from the various refinery units have a typical composition. This gas composition varies between flares due to the difference in the functions of the units each flare services. Gas composition is determined through the use of a gas chromatograph (GC). This average composition can vary during flaring incidents related to startup, shutdown, maintenance and turnaround activities, as well as emergency flaring situations. The following Table 2-13 shows composition data that is typical for the Alky Flare for the time between January 1, 2014 and December 31, 2014.

Table 2-14
Alky Flare Reductions Previously Realized

Year Installed or Implemented	Description	Estimated Reductions
2013	Sweep Gas Rotameter Study conducted to identify minimum Sweep Gas rate required to prevent backflow resulting from thermal contraction	NA
2013	Initial Pressure Relief Valve Leak Survey	NA
2012 – Present	Monthly Preventative Maintenance Rounds conducted by Operations to identify leaking PRVs	NA

2.3.7 Flare Specific Planned Reductions

Pursuant to the requirements set forth in the Consent Decree, future preventive measures are summarized in Table 2-15 below along with an anticipated schedule and potential reductions, where capable of being determined.

Table 2-15
Alky Flare Planned Reductions

Estimated Completion Date	Description	Estimated Reductions
December 31, 2016*	Install and commence operation of Flare Gas Recovery System 3, in accordance with the requirements of the BP Whiting Consent Decree.	231 MSCFD**

*Per the first amendment to the Consent Decree that became effective on April 3, 2015, the schedule for connecting Alky Flare to FGRS4 has been changed from before December 31, 2015 to before December 31, 2016

**Flare Gas Recovery will also absorb some portion of emissions contributions from Startup, Shutdown, and Malfunction; BPP expects the actual reduction to exceed the baseload volume.

Table 2-16
4UF Flare Waste Gas Volumetric and Mass Flow Rates

Waste Gas Volumetric Flow Rate (scfm)	Waste Gas Mass Flow Rate (pounds per hour)
208.9	1073.7

2.4.3 Baseload Waste Gas Flow Rate

The baseload Waste Gas flow rate can be determined for the flare systems by utilizing an ultrasonic flow meter and gas chromatograph (GC). The flow meter is capable of calculating the volumetric flow rate of the Vent Gas by determining the Vent Gas velocity and using the known inner diameter of the pipe in which the flow meter is installed. The GC allows for the calculation of the Waste Gas volumetric flow rate by determining the composition of the Vent Gas and so that inert species within the Vent Gas (Hydrogen, Oxygen, Nitrogen, Carbon Monoxide, Carbon Dioxide, and Water/Steam) can be excluded from the calculations. The Waste Gas flow rate reflects only the VOC content of the overall Vent Gas composition. The average baseload Vent Gas flow rate and the average baseload Waste Gas flow rate for the 4UF Flare (found below in Table 2-17) were determined using data collected between January 1, 2014 and December 31, 2014.

Table 2-17
4UF Flare Vent Gas and Waste Gas Volumetric Flow Rates

Vent Gas Volumetric Flow Rate (scfd)	Waste Gas Volumetric Flow Rate (scfd)
1,718,870	308,825

2.4.4 Identification of Constituent Gases

Under normal refinery operating conditions, gases vented to the flare from the various refinery units have a typical composition. This gas composition varies between flares due to the difference in the functions of the units each flare services. Gas composition is determined through the use of a gas chromatograph (GC). This average composition can vary during flaring incidents related to startup, shutdown, maintenance, and turnaround activities, as well as emergency flaring situations. The following Table 2-18 shows composition data that is typical for the 4UF Flare for the time between January 1, 2014 and December 31, 2014.

Table 2-19
4UF Flare Reductions Previously Realized

Year Installed or Implemented	Description	Estimated Reductions
2013	Sweep Gas Rotameter Study conducted to identify minimum Sweep Gas rate required to prevent backflow resulting from thermal contraction	NA
2013	Initial Pressure Relief Valve Leak Survey	NA
2012 – Present	Monthly Preventative Maintenance Rounds conducted by Operations to identify leaking PRVs	NA

2.4.7 Flare Specific Planned Reductions

Pursuant to the requirements set forth in the Consent Decree, future preventive measures are summarized in Table 2-20 below, along with an anticipated schedule and potential reductions, where capable of being determined.

Table 2-20
4UF Flare Planned Reductions

Estimated Completion Date	Description	Estimated Reductions
December 31, 2016	Install and commence operation of Flare Gas Recovery System 4, in accordance with the requirements of the BP Whiting Consent Decree.	309 MSCFD*

*Flare Gas Recovery will also absorb some portion of emissions contributions from Startup, Shutdown, and Malfunction; BPP expects the actual reduction to exceed the baseload volume.

Table 2-21
UIU Flare Waste Gas Volumetric and Mass Flow Rates

Waste Gas Volumetric Flow Rate (scfm)	Waste Gas Mass Flow Rate (pounds per hour)
539.3	1789.1

2.5.3 Baseload Waste Gas Flow Rate

The baseload Waste Gas flow rate can be determined for the flare systems by utilizing an ultrasonic flow meter and gas chromatograph (GC). The flow meter is capable of calculating the volumetric flow rate of the Vent Gas by determining the Vent Gas velocity and using the known inner diameter of the pipe in which the flow meter is installed. The GC allows for the calculation of the Waste Gas volumetric flow rate by determining the composition of the Vent Gas and so that inert species within the Vent Gas (Hydrogen, Oxygen, Nitrogen, Carbon Monoxide, Carbon Dioxide, and Water/Steam) can be excluded from the calculations. The Waste Gas flow rate reflects only the VOC content of the overall Vent Gas composition. The average baseload Vent Gas flow rate and the average baseload Waste Gas flow rate for the UIU Flare (found below in Table 2-22) were determined using data collected between January 1, 2014 and December 31, 2014.

Table 2-22
UIU Flare Vent Gas and Waste Gas Volumetric Flow Rates

Vent Gas Volumetric Flow Rate (scfd)	Waste Gas Volumetric Flow Rate (scfd)
1,385,559	770,467

2.5.4 Identification of Constituent Gases

Under normal refinery operating conditions, gases vented to the flare from the various refinery units have a typical composition. This gas composition varies between flares due to the difference in the functions of the units each flare services. Gas composition is determined through the use of a gas chromatograph (GC). This average composition can vary during flaring incidents related to startup, shutdown, maintenance and turnaround activities, as well as emergency flaring situations. The following Table 2-23 shows composition data that is typical for the UIU Flare for the time between January 1, 2014 and December 31, 2014.

Table 2-24
UIU Flare Reductions Previously Realized

Year Installed or Implemented	Description	Estimated Reductions
2013	Sweep Gas Rotameter Study conducted to identify minimum Sweep Gas rate required to prevent backflow resulting from thermal contraction	NA
2013	Initial Pressure Relief Valve Leak Survey	NA
2012 – Present	Monthly Preventative Maintenance Rounds conducted by Operations to identify leaking PRVs	NA

2.5.7 Flare Specific Planned Reductions

Pursuant to the requirements set forth in the Consent Decree, future preventive measures are summarized in Table 2-25 below along with an anticipated schedule and potential reductions, where capable of being determined.

Table 2-25
UIU Flare Planned Reductions

Estimated Completion Date	Description	Estimated Reductions
December 31, 2016	Install and commence operation of Flare Gas Recovery System 4, in accordance with the requirements of the BP Whiting Consent Decree.	770 MSCFD*

*Flare Gas Recovery will also absorb some portion of emissions contributions from Startup, Shutdown, and Malfunction; BPP expects the actual reduction to exceed the baseload volume.

Table 2-26
South Flare Waste Gas Volumetric and Mass Flow Rates

Waste Gas Volumetric Flow Rate (scfm)	Waste Gas Mass Flow Rate (pounds per hour)
0.0	0.0

2.6.3 Baseload Waste Gas Flow Rate

The Consent Decree specifically excludes South Flare from the baseload calculation requirement.

2.6.4 Identification of Constituent Gases

Under normal refinery operating conditions, gases vented to the flare from the various refinery units have a typical composition. This gas composition varies between flares due to the difference in the functions of the units each flare services. Gas composition is determined through the use of a gas chromatograph (GC). This average composition can vary during flaring incidents related to startup, shutdown, maintenance and turnaround activities, as well as emergency flaring situations. The following Table 2-27 shows composition data that is typical for the South Flare for the time between January 1, 2014 and December 31, 2014.

Table 2-27
South Flare Baseload Constituents

Component	Average Mole %
Nitrogen	6.60
Oxygen	0.02
Water/Steam	0.58
Carbon Dioxide	0.81
Carbon Monoxide	0.01
Hydrogen	6.62
Hydrogen Sulfide	0.41
Methane	69.14
Ethane	4.86
Ethylene	0.85
Acetylene	0.01
Propane	1.43
Propylene	0.61
iso-Butane	0.52
n-Butane	1.63
C_4 Olefins	0.23
C_5H_{12}	5.03

2.6.5 Waste Gas Mapping

Waste Gas mapping of No. 2 Coker, 12 Pipestill, SRC, VRU 300, and VRU 400 units was performed through the use of instrumentation data. Data from the ultrasonic flow meter was used to determine the total flow through the flare header. Sweep Gas rates

2.7 GOHT Flare

2.7.1 Equipment and Controls

The GOHT Flare is a steam-assisted, elevated flare that was constructed in 2012. The flare header system for the GOHT Flare collects and delivers Vent Gases from the GOHT unit. Gases which are vented from these areas, either from system over-pressurization caused by a malfunction or any other reason, flow into the GOHT Flare Knockout Drum (D-946) and, ultimately, the flare tip.

The GOHT Flare has one knockout drum, which is designed to separate and collect liquid from a Waste Gas stream and ensure that only gas is sent to the flare tip. The remaining liquid is recycled back into the refinery process via knockout drum pumps. Sources entering the flare header system will flow to the knockout drum for liquid separation before being sent to the flare stack for combustion.

The GOHT Flare is identified as S/V 802-03 in the Refinery. The flare stack stands 316 feet above the ground surface and has a flare tip diameter of 60 inches. The flare tip is model 60" JZ HSA1-SH-60, manufactured by John Zink, and was installed as part of the initial construction of the GOHT Flare in February 2012. The system contains a total of four 1" pilot lights. An ignition system containing four 1" explosion and weather proof ignition tubes utilizing Flame Front Generator (FFG) ignition provides the energy to cause the desired combustion of the Pilot Gas.

A series of monitoring instruments including Waste Gas, Purge Gas, and steam flow meters and a gas chromatograph (GC) analyze the inputs to the flare header prior to the flare tip. The Waste Gas flow reading, along with information regarding composition from the GC, is used to signal the steam controller to adjust the amount of steam sent to the flare tip. The design of the flare permits adjusting the amount of steam, allowing the flare to operate with optimal conditions to ensure proper combustion efficiency (i.e. >98%). Additionally, recording flow rates and compositions allows BPP to evaluate the potential sources of flow more accurately and develop strategies for eliminating or reducing Waste Gas flow.

2.7.2 Waste Gas Volumetric and Mass Flow Rates

The Waste Gas volumetric and mass flow rates can be determined for the flare systems by utilizing an ultrasonic flow meter and gas chromatograph (GC). The volumetric flow rate of the Vent Gas can be derived by an ultrasonic flow meter by determining the Vent Gas velocity and using the known inner diameter of the pipe in which the flow meter is installed. The GC allows for the calculation of the Waste Gas volumetric and mass flow rates by determining the composition of the Vent Gas so that inert species within the Vent Gas (Hydrogen, Oxygen, Nitrogen, Carbon Monoxide, Carbon Dioxide, and Water/Steam) can be excluded from the calculations. The average Waste Gas volumetric and mass 30 day average flow rates for the GOHT Flare (found below in Table 2-29) were determined using data collected between January 1, 2014 and December 31, 2014.

2.7.5 Waste Gas Mapping

Waste Gas mapping of the GOHT unit was performed through the use of instrumentation data. Data from the ultrasonic flow meter was used to determine the total flow through the flare header. Sweep Gas rates were determined by using rotameter data, and the Waste Gas contributions of individual unit headers were determined using data from flow meters monitoring flow from the individual units to the main flare header. The resulting block flow diagram (BFD) of the overall flare layout is provided in Attachment G. It is of note that these flows are only a snapshot in time and can possibly change depending on process unit events.

2.7.6 Past Emission Reductions

Provided below in Table 2-31, is a list of preventive measures completed over the past 3 years. Because the GOHT Flare was constructed recently, BP (and its contractors) had the opportunity to identify design strategies to minimize flow to the flare header from each connection. The identified design strategies were implemented in the construction of the flare header and as such, the flare header system has been constructed to achieve minimization of flow to the header.

Table 2-31
GOHT Flare Reductions Previously Realized

Year Installed or Implemented	Description	Estimated Reductions
2012	Install and commence operation of Flare Gas Recovery System 2, in accordance with the requirements of the BP Whiting Consent Decree.	472 MSCFD*

*Flare Gas Recovery will also absorb some portion of emissions contributions from Startup, Shutdown, and Malfunction; BPP expects the actual reduction to exceed the baseload volume.

2.7.7 Flare Specific Planned Reductions

At present, the flows to the GOHT Flare are expected to be completely minimized, as the FGR system was designed to handle the anticipated normal flows from the GOHT Flare header. In the event that routine breakthroughs are observed after the GOHT Flare becomes operational, BPP will conduct further minimization investigations.

The FGR system installed on the GOHT Flare consists of two (2) liquid ring compressors (LRCs). Each compressor has a capacity of 1,053 scfm, providing a total recovery capacity of 2,106 scfm. Typical recovery rates during normal operation are approximately 328 scfm.

Table 2-32
DDU Flare Waste Gas Volumetric and Mass Flow Rates

Waste Gas Volumetric Flow Rate (scfm)	Waste Gas Mass Flow Rate (pounds per hour)
720.5	2269.4

2.8.3 Baseload Waste Gas Flow Rate

The baseload Waste Gas flow rate can be determined for the flare systems by utilizing an ultrasonic flow meter and gas chromatograph (GC). The flow meter is capable of calculating the volumetric flow rate of the Vent Gas by determining the Vent Gas velocity and using the known inner diameter of the pipe in which the flow meter is installed. The GC allows for the calculation of the Waste Gas volumetric flow rate by determining the composition of the Vent Gas and so that inert species within the Vent Gas (Hydrogen, Oxygen, Nitrogen, Carbon Monoxide, Carbon Dioxide, and Water/Steam) can be excluded from the calculations. The Waste Gas flow rate reflects only the VOC content of the overall Vent Gas composition. The average baseload Vent Gas flow rate and the average baseload Waste Gas flow rate for the DDU Flare (found below in Table 2-33) were determined using data collected between January 1, 2014 and December 31, 2014.

Table 2-33
DDU Flare Vent Gas and Waste Gas Volumetric Flow Rates

Vent Gas Volumetric Flow Rate (scfd)	Waste Gas Volumetric Flow Rate (scfd)
1,783,086	1,032,038

2.8.4 Identification of Constituent Gases

Under normal refinery operating conditions, gases vented to the flare from the various refinery units have a typical composition. This gas composition varies between flares due to the difference in the functions of the units each flare services. Gas composition is determined through the use of a gas chromatograph (GC). This average composition can vary during flaring incidents related to startup, shutdown, maintenance and turnaround activities, as well as emergency flaring situations. The following Table 2-34 shows composition data that is typical for the DDU Flare for the time between January 1, 2014 and December 31, 2014.

Table 2-35
DDU Flare Reductions Previously Realized

Year Installed or Implemented	Description	Estimated Reductions
2013	Sweep Gas Rotameter Study conducted to identify minimum Sweep Gas rate required to prevent backflow resulting from thermal contraction	NA
2013	Initial Pressure Relief Valve Leak Survey	NA
2012 – Present	Monthly Preventative Maintenance Rounds conducted by Operations to identify leaking PRVs	NA

2.8.7 Flare Specific Planned Reductions

Pursuant to the requirements set forth in the Consent Decree, BPP will continue to investigate ways to reduce flaring potential from sources.

steam control logic. A gas chromatograph is used in conjunction to determine the Vent Gas composition and provide a more accurate indication of hydrocarbon levels in the Vent Gas.

3.2.2 Vent Gas Composition

The Vent Gas will be monitored by a gas chromatograph to determine Vent Gas composition and heat content (Btu/scf). This monitoring system provides a data point approximately once every ten minutes which is used to verify molecular weight readings from the flow meter. A sulfur analyzer in the GC is also capable of determining the amount of hydrogen sulfide for Vent Gas sulfur content purposes.

3.2.3 Volumetric Flow – Vent Gas

Ultrasonic flow meters installed in the flare system provide the flow velocity of the Vent Gas on a continuous basis. The volumetric flow of the Vent Gas can be derived from the Vent Gas velocity by incorporating the cross sectional area of the pipe in which the flow meter is installed. The flow meter directly provides the volumetric flow rate so that no external calculations are required.

3.2.4 Mass Flow – Steam and Vent Gas

Ultrasonic flow meters are also used to determine the mass flow rates of the steam and Vent Gas on a continuous basis. Using the molecular weight and molar flow rate of the Vent Gas, the mass flow rate can be calculated. The flow meter directly outputs the mass flow rate with no need for external calculations.

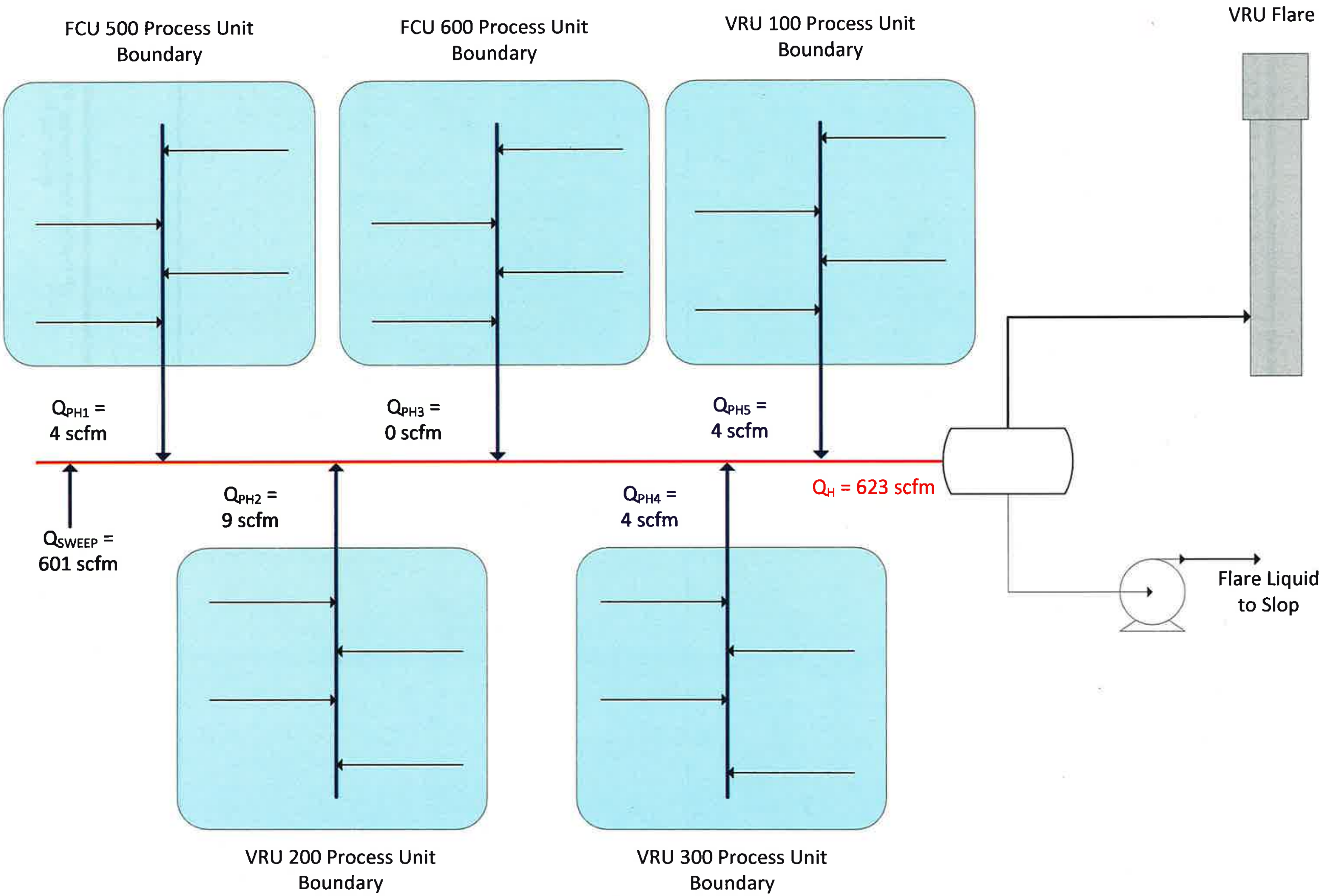
3.3 Major Maintenance/Turnaround

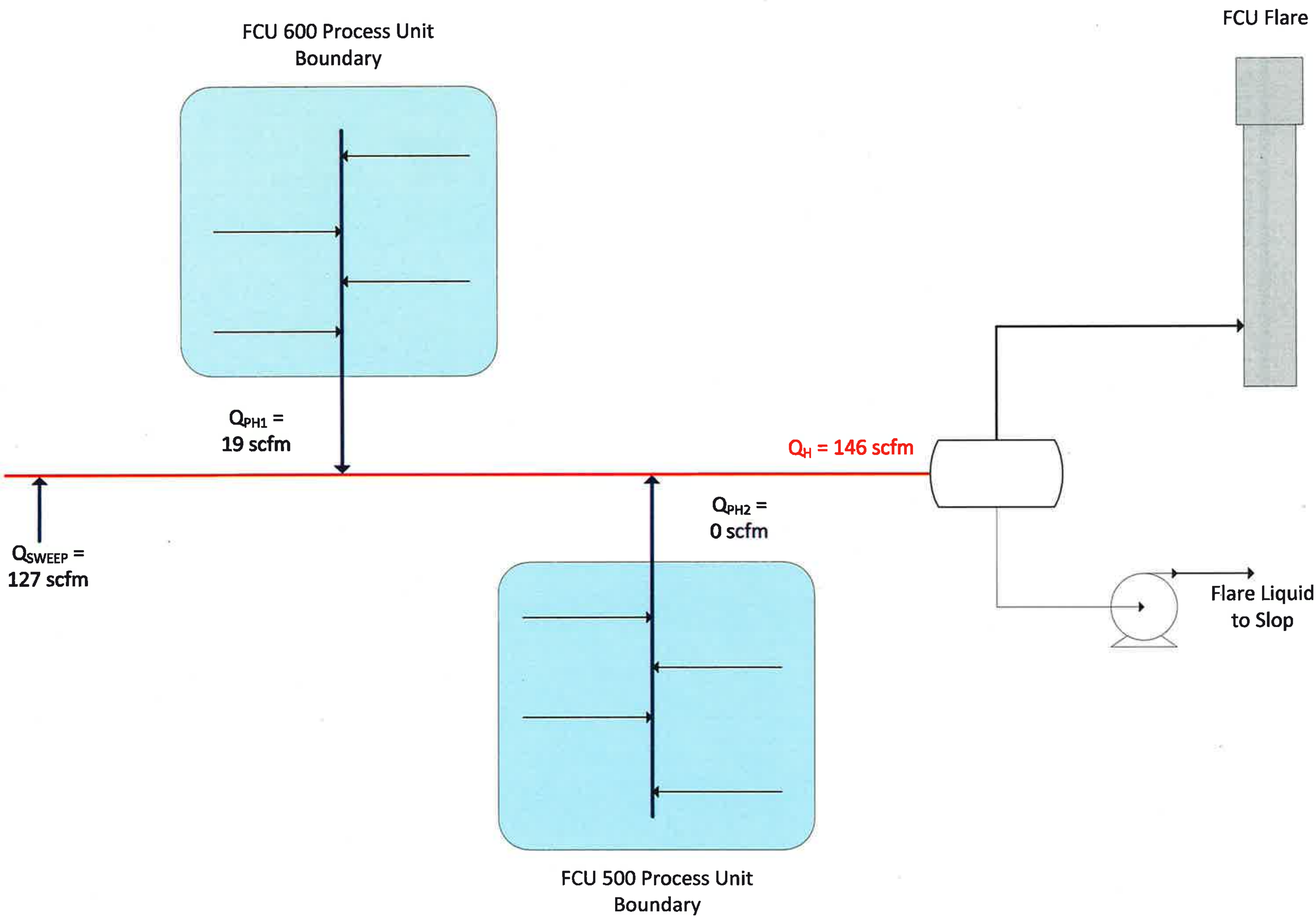
During maintenance on equipment and processes it is often necessary to purge equipment of all vapors for safety and environmental reasons. These purges are sent to the relief gas system potentially leading to flaring; however, on flares equipped with Flare Gas Recovery, BPP sequences these purges to avoid overloading the FGR. BPP attempts to limit maintenance requiring equipment purges to flare; however, this can be unavoidable in order to provide for internal inspections and equipment cleanout or replacement. For the purpose of this section, maintenance activities are scheduled process unit turnarounds as well as near-term shutdowns planned for other maintenance activities. BPP evaluated these past activities over the last three (3) years to determine the feasibility of reducing or eliminating flaring during these activities in the future. The evaluation consisted of reviewing the Refinery's Flaring Incident Database as well as SSM Plans and Event Forms required by Refinery MACT CC (e.g. 40 CFR 63 Subpart CC). Table 3-1 lists the results of this evaluation.

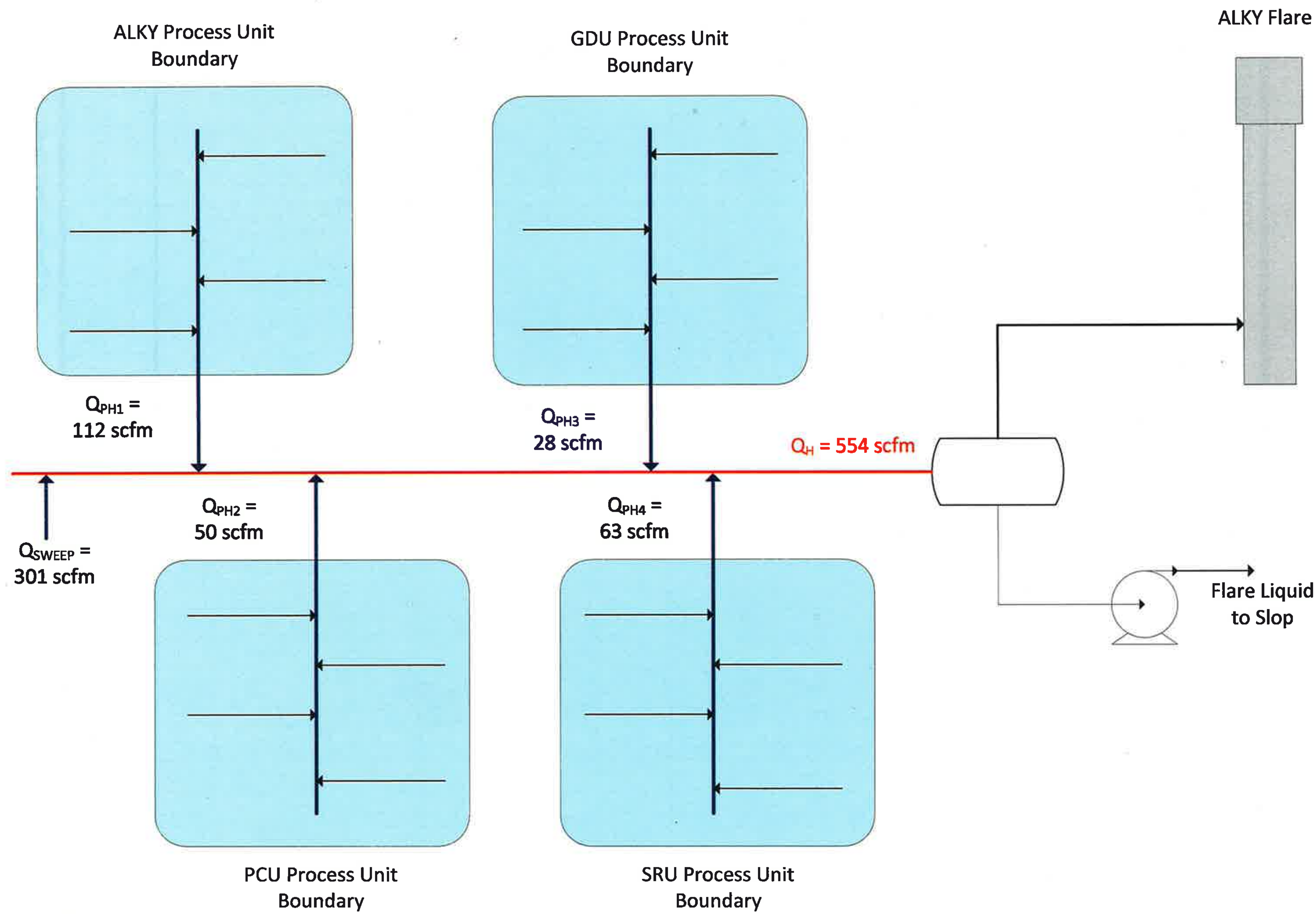
Hydrocarbon Flaring Incidents root cause analyses were reviewed from the Date of Entry through December 31, 2014 and no recurrent equipment failures were identified. Future revisions will identify and report recurrent equipment failures, as necessary, covering the period from Date of Entry until the date of submission until November 6, 2017, at which point the previous five (5) years will be reviewed.

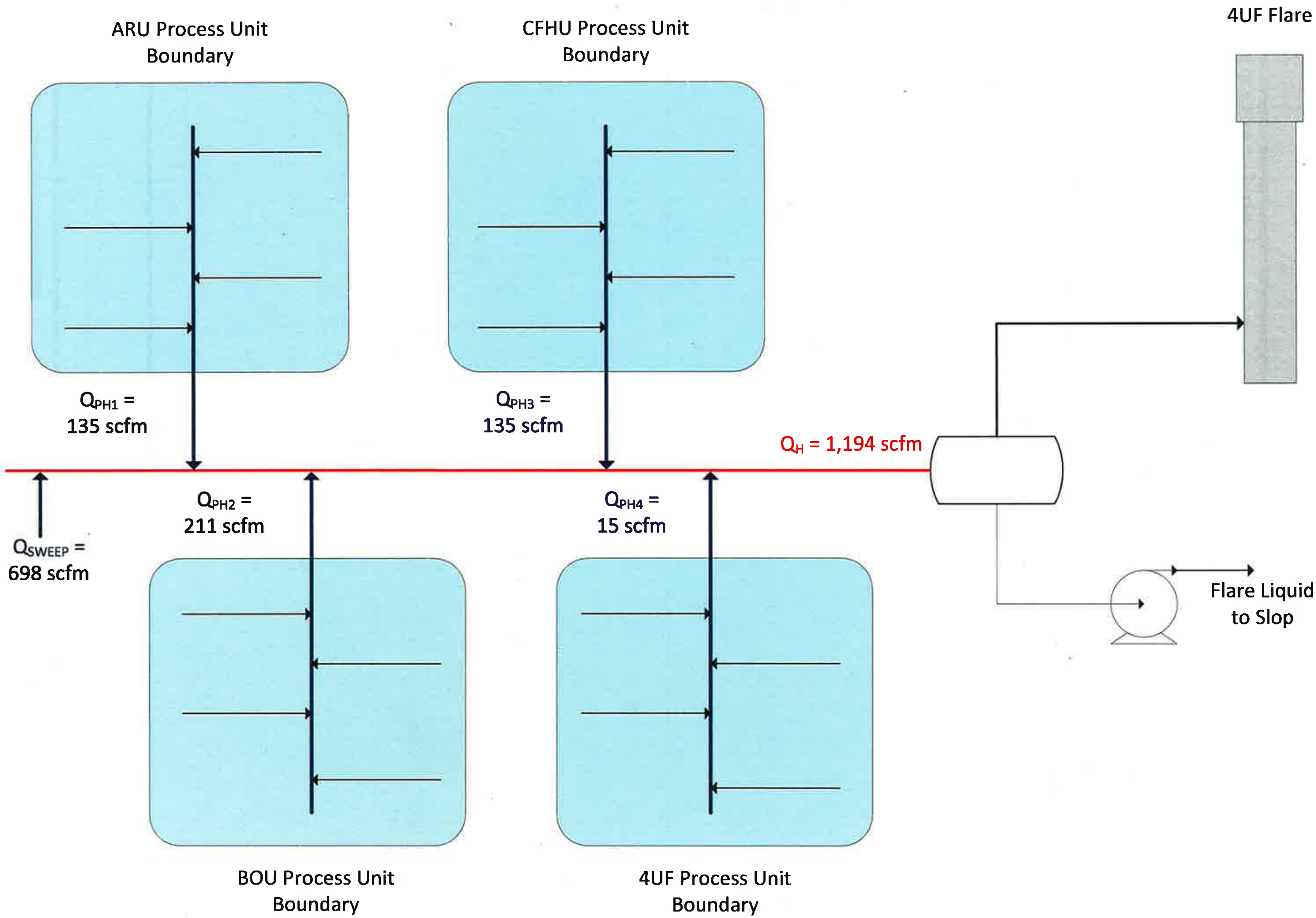
3.5 Other Potential Flaring Events

For events with a potential to cause flaring, planning is conducted to determine ways to avoid flaring. This includes major maintenance and turnarounds and new installations/upgrades. Project committees are tasked with developing strategies to limit the amount of flaring to only the instances that are absolutely necessary. Additionally, when there is a flaring event, processes are in place to evaluate the extent of the event and determine the cause. Using root cause analyses, the Whiting Refinery will evaluate the flaring event and use the data collected to plan for better procedures and processes or more appropriate equipment. Lastly, potential preventive measures are selected based on the planning and evaluations and are incorporated into subsequent revisions of this document and implemented at BPP.

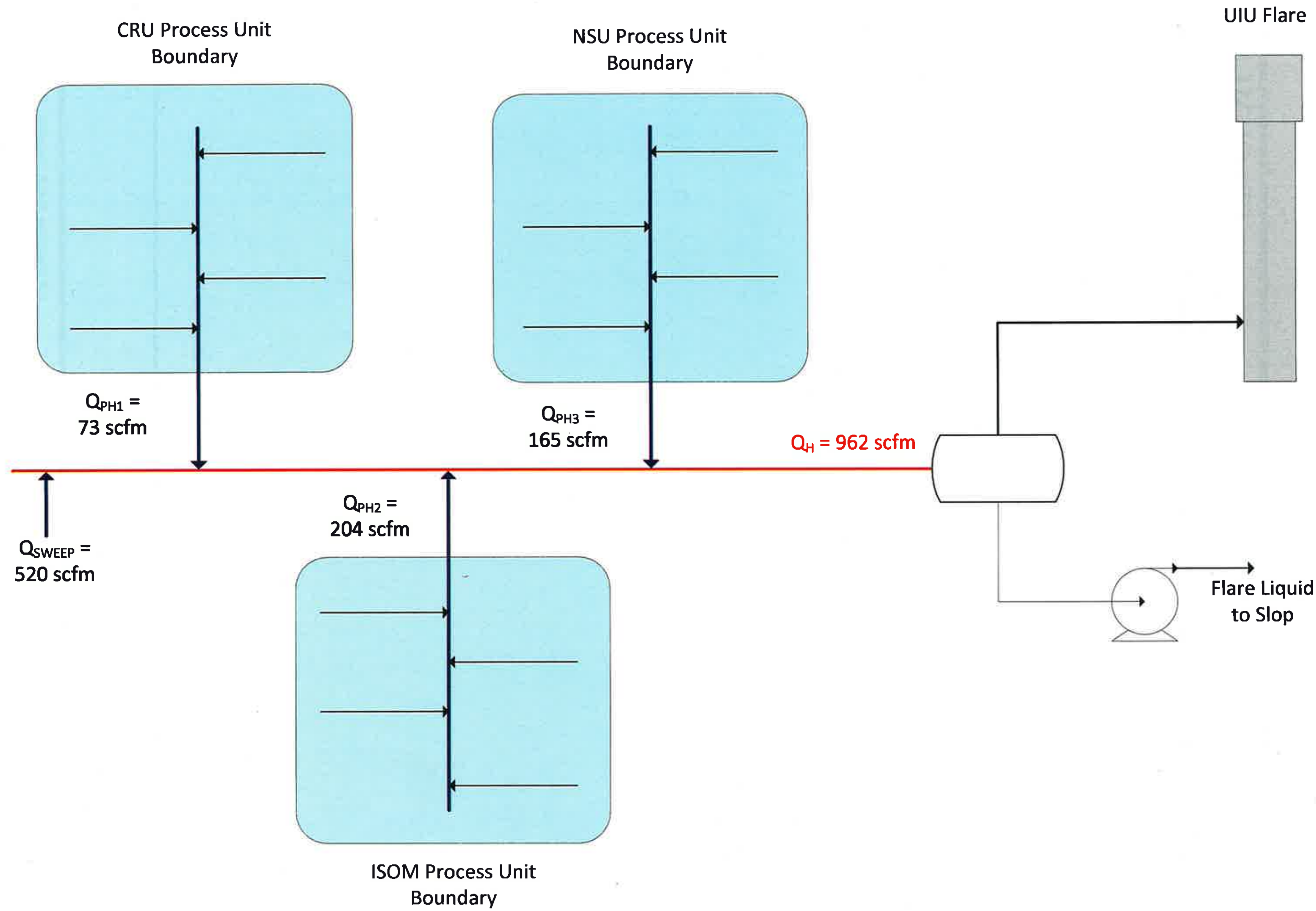

FCU 500 Process Unit Boundary
FCU 600 Process Unit Boundary
VRU 100 Process Unit Boundary
VRU Flare
Q_{PH1} = 4 scfm
Q_{PH3} = 0 scfm
Q_{PH5} = 4 scfm
Q_{PH2} = 9 scfm
Q_{PH4} = 4 scfm
Q_{H} = 623 scfm
Q_{SWEEP} = 601 scfm
Flare Liquid to Slop
VRU 200 Process Unit Boundary
VRU 300 Process Unit Boundary

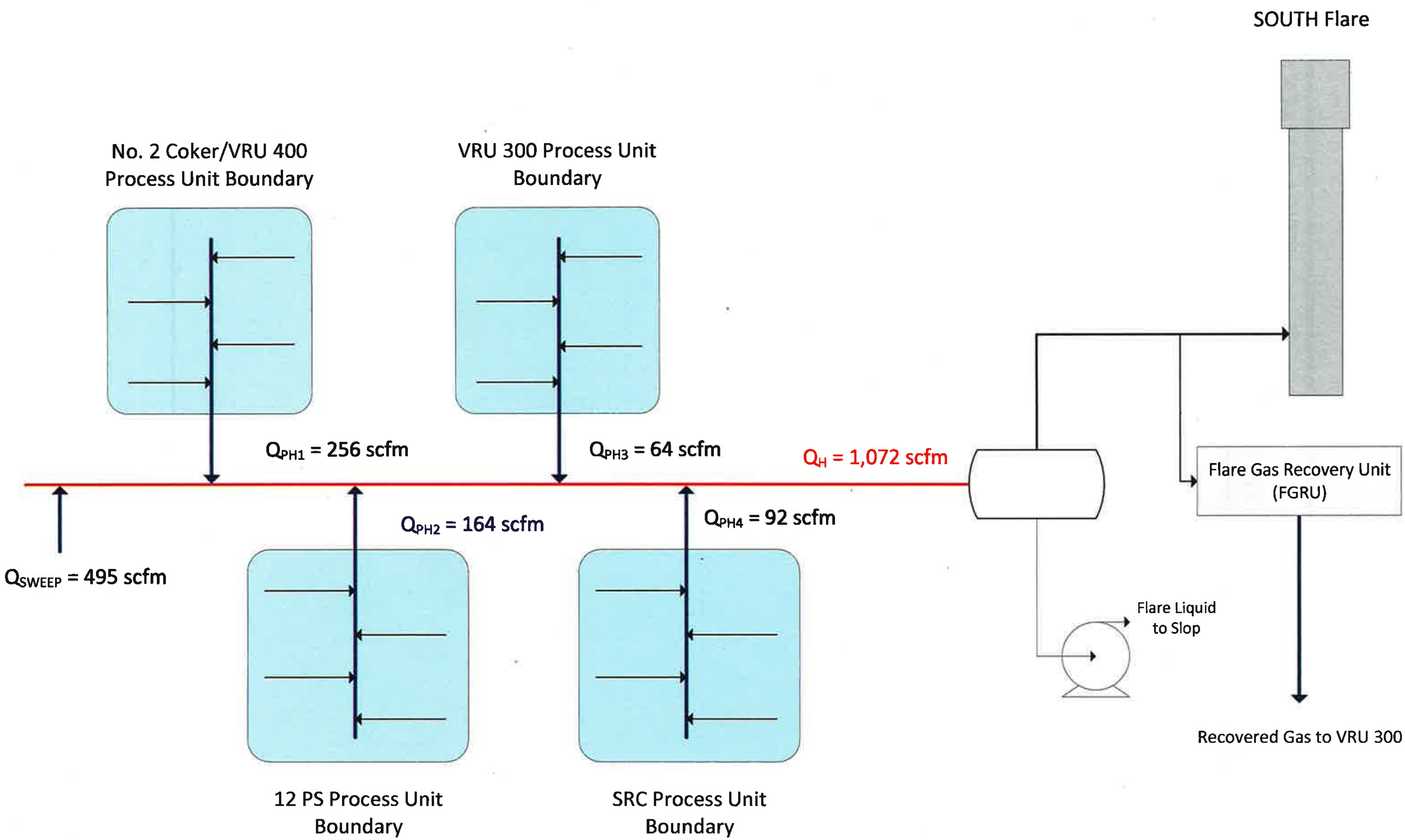

FCU 600 Process Unit Boundary
FCU Flare
Q_{PH1} = 19 scfm
Q_H = 146 scfm
Q_{SWEEP} = 127 scfm
Q_{PH2} = 0 scfm
Flare Liquid to Slop
FCU 500 Process Unit Boundary


ALKY Process Unit Boundary
GDU Process Unit Boundary
ALKY Flare
Q_{PH1} = 112 scfm
Q_{PH3} = 28 scfm
Q_H = 554 scfm
Q_{PH2} = 50 scfm
Q_{PH4} = 63 scfm
Q_{SWEEP} = 301 scfm
Flare Liquid to Slop
PCU Process Unit Boundary
SRU Process Unit Boundary

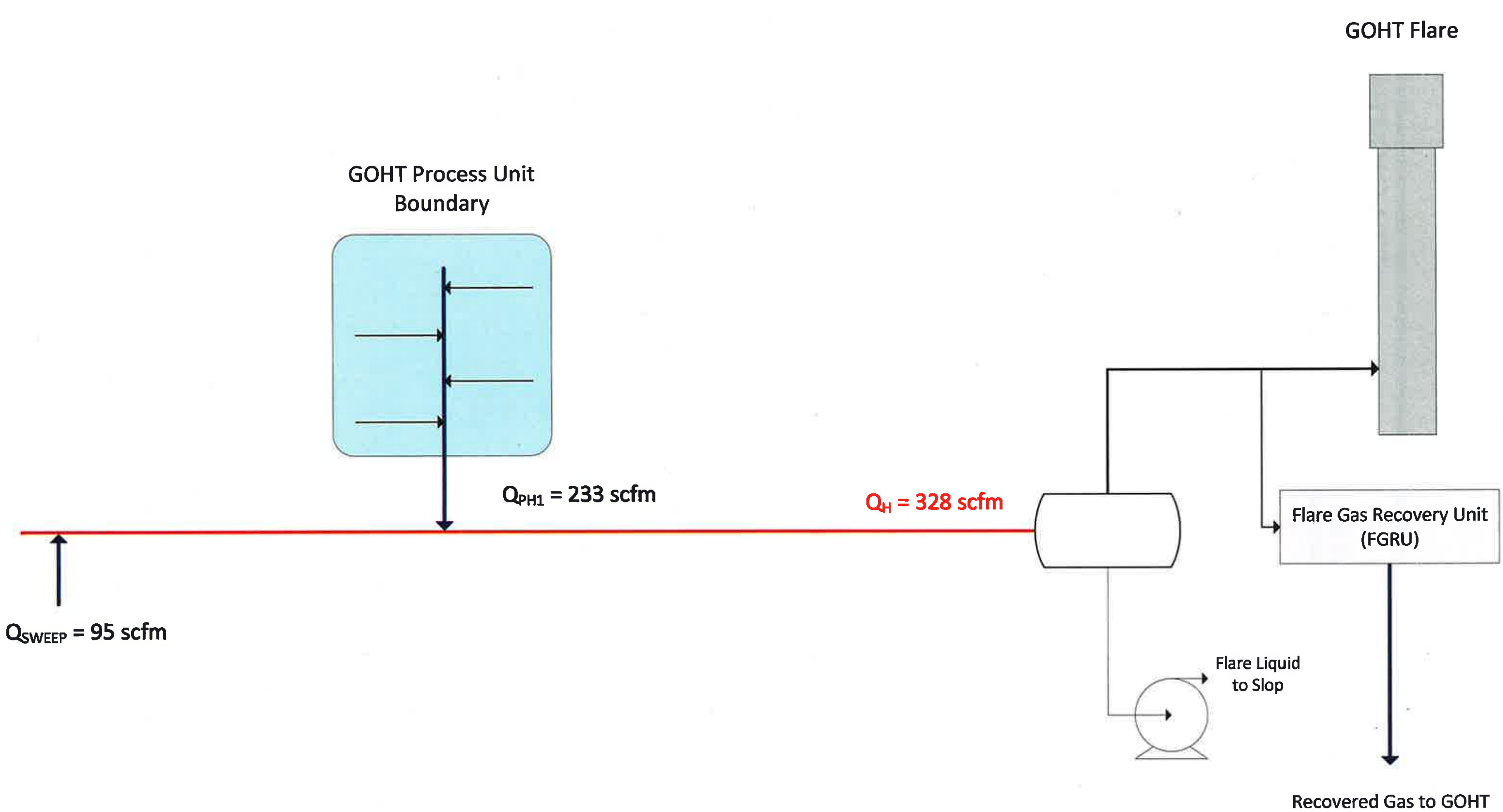


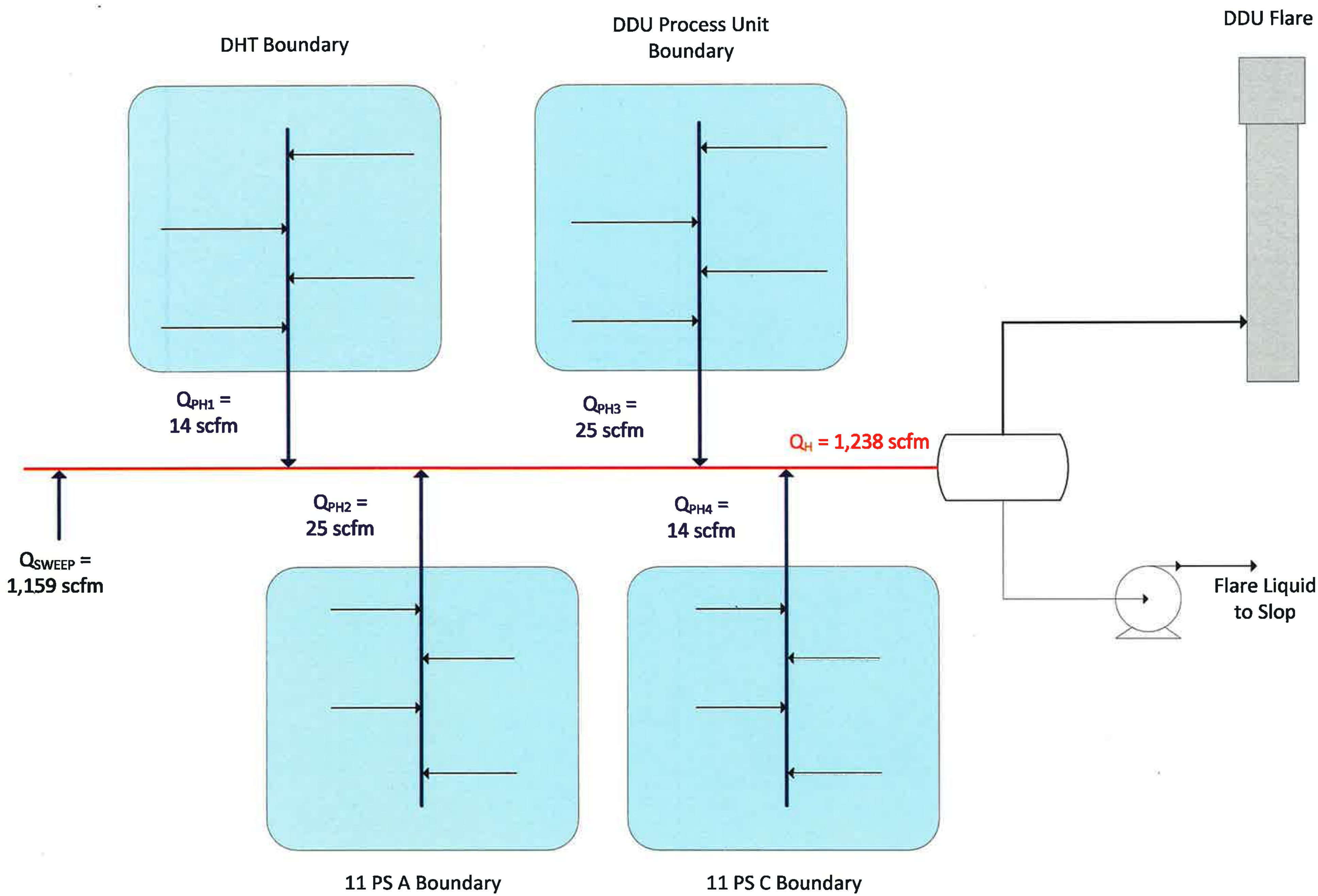
ARU Process Unit Boundary
CFHU Process Unit Boundary
4UF Flare
QPH1 = 135 scfm
QPH3 = 135 scfm
QH = 1,194 scfm
QPH2 = 211 scfm
QPH4 = 15 scfm
QSWEEP = 698 scfm
Flare Liquid to Slop
BOU Process Unit Boundary
4UF Process Unit Boundary


CRU Process Unit Boundary
NSU Process Unit Boundary
UIU Flare
Q_{PH1} = 73 scfm
Q_{PH3} = 165 scfm
Q_H = 962 scfm
Q_{PH2} = 204 scfm
Q_{SWEEP} = 520 scfm
Flare Liquid to Slop
ISOM Process Unit Boundary



SOUTH Flare
No. 2 Coker/VRU 400
Process Unit Boundary
VRU 300 Process Unit
Boundary
Q_{PH1} = 256 scfm
Q_{PH3} = 64 scfm
Q_H = 1,072 scfm
Flare Gas Recovery Unit
(FGRU)
Q_{PH2} = 164 scfm
Q_{PH4} = 92 scfm
Q_{SWEEP} = 495 scfm
Flare Liquid
to Slop
Recovered Gas to VRU 300
12 PS Process Unit
Boundary
SRC Process Unit
Boundary


GOHT Flare
GOHT Process Unit Boundary
Q_{PH1} = 233 scfm
Q_H = 328 scfm
Flare Gas Recovery Unit (FGRU)
Q_{SWEEP} = 95 scfm
Flare Liquid to Slop
Recovered Gas to GOHT


DHT Boundary
DDU Process Unit Boundary
DDU Flare
Q_{PH1} = 14 scfm
Q_{PH3} = 25 scfm
Q_H = 1,238 scfm
Q_{PH2} = 25 scfm
Q_{PH4} = 14 scfm
Q_{SWEEP} = 1,159 scfm
Flare Liquid to Slop
11 PS A Boundary
11 PS C Boundary